L-164

SOIL REACTION (pH) RANGES

TEXAS A&M UNIVERSITY
TEXAS AGRICULTURAL EXTENSION SERVICE
J. E. HUTCHISON, DIRECTOR, COLLEGE STATION, TEXAS

SOIL REACTION (pH) RANGES

CHARLES D. WELCH
Extension Soil Chemist
Texas A&M University

GROWTH AND DEVELOPMENT of plants are influenced by many factors. These factors include climatic conditions, diseases, insects, soil texture, soil structure, soil fertility and management practices. If any of these factors are unfavorable, plant growth will be unsatisfactory.

One soil characteristic which can be used to determine whether a soil is satisfactory with respect to certain characteristics is the soil reaction or soil pH. Most plants grow satisfactorily within a certain pH range because certain chemical characteristics of the soil are more favorable for plant growth.

The pH range considered desirable for different plants is given. If good management is used and if other factors are favorable, many of the plants listed will grow and develop satisfactorily outside the pH range indicated. Field crops and vegetables generally are not as sensitive to soil reaction as flowers and shrubs.

Soil reaction (or pH) can be determined only by a soil test. A laboratory test with a pH meter gives most accurate results. Soil test kits containing color indicators can be used but are less accurate.

Certain soil amendments change the soil reaction. Ground agricultural limestone can increase soil pH (make it less acid). Other liming materials, such as quicklime, ground marl or wood ashes also can be used.

To decrease soil pH (make it more acid) elemental sulfur, sulfuric acid, iron sulfate (copperas) or aluminum sulfate can be used. Apply these soil amendments and work them into the soil at least 3 months ahead of planting for best results. Application of organic material, such as barnyard manure or compost, also reduces soil pH. Certain fertilizers, such as ammonium sulfate and other ammonium sources make a soil more acid, whereas some, such as sodium nitrate, make the soil more alkaline.

The quantity of these amendments to be used depends not only on the present soil pH but also on soil texture, organic matter content and exchange capacity of the soil. In view of this, no general recommendations for using soil amendments can be given. Base the rate to be used on a soil test.

Soil pH and its meaning in relation to lime requirements and fertility conditions are given in the following table.

FIELD AND FORAGE CROPS

Crop	pH Range
Alfalfa, sweetclover	6.5 - 8.0
Alsike clover, white clover	6.0 - 7.0
Bermudagrass, sudangrass, sorgrass	5.5 - 7.5
Corn	6.0 - 7.5
Cotton	6.0 - 8.0
Cowpeas, vetch	6.0 - 7.5
Crimson clover	6.0 - 7.5
Dallisgrass	6.0 - 7.0
Flax	6.0 - 7.8
Lawn grasses (Bermuda, San Augustine, carpet)	5.5 - 7.5
Lespedeza	5.0 - 6.5
Millet	5.5 - 7.5
Red top	6.0 - 7.5
Small grains (oats, wheat, barley, rye)	5.5 - 8.0
Sorghum (For syrup only)	5.5 - 6.5
(For forage or grain)	5.5 - 7.0

TABLE I. SUMMARY OF SOIL REACTION, LIME REQUIREMENTS AND PLANT-NUTRIENT RELATIONSHIPS.*

pH	4.0		5.0		6.0	7.0	8.0		9.0	10.0
Acidity	Extremely acid	Very strongly acid	Strongly acid	Medium acid	Slightly acid	Neutral	Mildly alkaline	Moderately alkaline	Strongly alkaline	Very strongly alkaline
Lime Requirements	Lime needed except for crops requiring acid soil		Lime needed for all but acid-tolerant crops		Lime needed on some crops	Lime generally not needed	No lime needed		No lime needed. Sodium usually present. Gypsum, sulfur, etc. needed for replacing sodium.	
Occurrence	Few East Texas soils		Very common in East Texas soils		Few East Texas soils, common on Coast Prairie, few in West, Central and South Texas		Common in Coast Prairie, and all areas from Blacklands to the West		Common in areas where irrigation water contains sodium	
Fertility Conditions	Phosphorus fixed Calcium and potassium leach Iron, aluminum and manganese soluble Bacterial activity limited Fungi thrive				Phosphorus soluble Calcium generally present in adequate quantities Desirable bacterial activity		Phosphorus fixed Iron, manganese, zinc and other trace elements less available			

*Adapted from "Fundamentals of Soil Science," Millar and Turk, 1943.

Crop	pH Range
Soybeans	5.5 - 7.5
Sugar beets	7.0 - 8.0
Velvet beans	6.0 - 7.0

VEGETABLES

Crop	pH Range
Asparagus	6.0 - 7.0
Beans	6.0 - 7.5
Beans, Lima	5.5 - 7.5
Beets	6.0 - 7.5
Blackberries (most varieties)	6.0 - 8.0
Blueberries	5.0 - 6.0
Broccoli	6.0 - 8.0
Brussel sprouts	6.0 - 7.5
Cabbage	6.0 - 8.0
Cantaloupe	6.0 - 8.0
Carrot	6.0 - 7.5
Cauliflower	5.5 - 7.5
Cucumber	5.5 - 8.0
Dewberry	5.0 - 6.5
Eggplant	5.5 - 7.5
Lettuce	6.0 - 7.5
Mustard	5.5 - 6.5
Okra	6.0 - 7.5
Onion	6.0 - 8.0
Parsley	6.0 - 8.0
Peas	6.0 - 8.0
Pepper	5.5 - 7.0
Pumpkin	5.5 - 7.0
Irish potato (For control of scab)	4.8 - 5.4
Irish potato (For plant growth and yield)	5.5 - 7.5
Sweet potato	5.0 - 7.0
Radish	6.0 - 8.0
Spinach	6.0 - 8.0
Strawberries	5.0 - 7.5

Crop	pH Range
Sweet corn	6.0 - 7.5
Tomato	6.0 - 7.5
Turnip	5.5 - 7.0
Watermelon	6.0 - 7.5

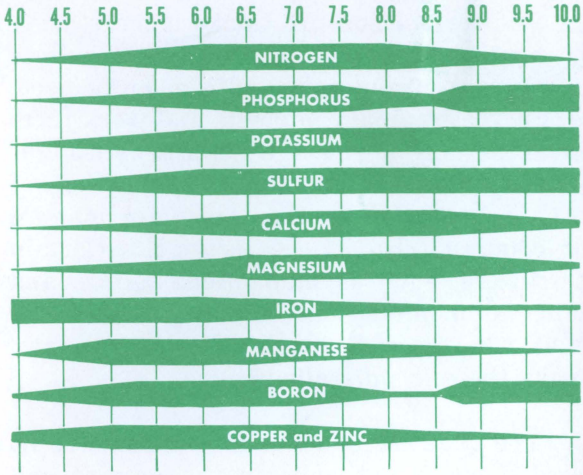
TREES - SHRUBS - FRUITS

Plant	pH Range
Abelia	6.0 - 8.0
Althea	6.0 - 8.0
Apple	6.0 - 8.0
Apricots	6.0 - 8.0
Azalea Formosa	5.0 - 6.0
Butterflybush	6.0 - 8.0
Camellia	4.0 - 6.0
Cape jasmine	5.0 - 7.0
Cherry	6.0 - 8.0
Elm (American)	6.0 - 8.0
Elm (Chinese)	6.0 - 8.0
Grape	6.0 - 8.0
Grapefruit	6.0 - 8.0
Holly (American)	5.0 - 6.0
Holly (Chinese)	6.0 - 7.5
Lemon	6.0 - 8.0
Locust	6.0 - 8.0
Magnolia	5.0 - 7.0
Oak, chestnut	6.0 - 7.0
Oak, pin	6.0 - 7.0
Oak, red	6.0 - 7.0
Oak, white	6.0 - 8.0
Orange	6.0 - 8.0
Peach	6.0 - 7.5
Pear	5.8 - 7.5
Pecan	6.0 - 7.8
Pine (Southern)	5.0 - 6.0
Plum	6.0 - 7.5

Plant	pH Range
Privet	6.0 - 7.5
Tung	5.0 - 6.0
Yaupon	5.5 - 7.5

FLOWERS

Plant	pH Range
Alyssum	6.0 - 8.0
Aster (flowering)	5.5 - 6.5
Aster (many species)	6.0 - 8.0
Begonia	6.0 - 7.0
Calendula	6.0 - 8.0
Candytuft	6.0 - 7.0
Cannas	6.0 - 8.0
Chrysanthemum	6.0 - 8.0
Clematis	6.0 - 7.5
Clematis Crispa	5.0 - 6.5
Dahlia	6.0 - 8.0
Gaillardia	6.0 - 8.0
Gladiolus	6.0 - 8.0
Geranium	6.0 - 8.0
Heliotrope	6.0 - 8.0
Iris (water flags)	5.0 - 6.0
Iris (common bearded)	6.0 - 8.0
Iris (swamp)	5.0 - 6.0
Larkspur	6.0 - 8.0
Lily	5.0 - 6.5
Lily (hemerocallis)	6.0 - 8.0
Narcissus	5.0 - 7.0
Pansy	6.0 - 7.5
Petunia	6.0 - 8.0
Phlox annual	6.0 - 8.0
Rose	5.5 - 7.5
Stock	6.0 - 7.0
Snapdragon	6.0 - 7.0
Zinnia	6.0 - 8.0



Availability of nutrients (ph range). Bar represents degree of availability.

As indicated from the chart, the availability of most plant nutrients is influenced by the soil pH. A marked reduction in the availability of the micronutrients, iron, manganese, boron, copper and zinc is noted as the pH approaches 8.0 The importance of this decrease varies among soils and crops. Most crops require from a fraction of a pound to only a few pounds per acre of each micronutrient. Therefore, soils that contain relatively large quantities of these nutrients still are able to supply an adequate amount for most crops even under high pH conditions. Plants also vary in their requirements and capacity to remove or absorb nutrients from soils.

Maintaining a pH in the range between 6.5 and 7.5 is considered desirable for maximum availability of all nutrients in most soils.

Cooperative Extension Work in Agriculture and Home Economics, Texas A&M University and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
10M—9-64, Revised.